

Automatic Attendance Registration System based Mobile Cloud Computing

Majid O. Al-Shezawi, Jabar H. Yousif, Ibtisam A. AL-Balushi

Abstract— the aim of this paper is to discuss the implementation and designing an automatic attendance registration system based Mobile Cloud Computing. A prototype for managing and control the registration of student attendance is developed using Phone Gap and jQuery mobile framework. However, the mobile app is designed to help students for checking their presence details, such as the number of missed classes, and the percentage of absence. Automate the process of registering students' attendance using Bluetooth technology will reduce the falsification of attendance which will make students to attend classes regularly. Moreover, using the Bluetooth address for the student attendance registration based on the cloud will be costless, that is because all students have their smartphones with built-in Bluetooth. Moreover, building and designing a desktop and cross-platform mobile application to control and follow the attendance process and print out the suitable reports. However, the benefits of using cloud computing and mobile technology in education institution will cost less than a traditional data center. The proposed registration system is less the time of recording the student attendance with high accuracy.

Index Terms— Cloud Computing, Mobile Cloud Computing, Attendance Registration System, Identification Technologies.

I. INTRODUCTION

Cloud Computing has recently appeared in IT industry as a new Model for delivering secure, fault-tolerant, reliable, sustainable, and scalable computational services through the Internet. These services include platform as a service, infrastructure as a service, and software as a service. In the last few years, Cloud Computing draws the attention of business owners since it eliminates the requirement of planning for the provision of resources in the future as well as it allows companies to start without thinking about IT infrastructures such as servers, network, and data storages. National Institute of Standards and Technology (NIST) define Cloud computing as "a model for enabling convenient on-demand network access to a shared pool of configurable computing resources, such as networks, servers, storage, applications, and services, that can rapidly be provisioned and released with minimal management effort or service provider interaction"[1]. The structure of Cloud Computing can be divided into four layers: hardware, data centers, infrastructure, and platform and applications layer.

This paper proposes a Mobile Cloud Computing model for automatic academic attendance system. Cloud Computing provides a significant number of computing resources, which can be used to come over these limitations on mobile devices. Combining the mobile devices and Cloud Computing can create a new structure called Mobile Cloud Computing (MCC). In MCC structure, data storage and data processing systematically saved outside mobile devices.

Educational institutions have now adopted the use of Information and Communication Technologies to achieve more efficient and competitive system in delivering both, lectures and administrative processes. Furthermore, if the students want to check their fees, then they can enroll courses online payment, or check their attendance. Therefore, there is a need to automate university's processes and work. Integrated Academic Management Systems is expensive. However, finding alternative ways to meet customers' expectations within constrained budgets is an important matter [2]. The registration of students' attendance is done manually, which considered as a serious issue. It is not a trivial task due to time-consuming, and it is hard work to record by the lecturer in each class even when the classroom is small. Thus, repeating of the recording process for each class will result in an increased level of the possibility of failure to get accurate results. There is a big correlation relation between the attendance and the academic success [3]. Hence, attending lectures on a regular basis helps students to get the correct level of understanding.

The study of possible technologies helps to propose a solution for implementing an automatic model for academic attendance system. This paper aims to automate the process of registering the student's attendance to reduce the time and effort required to complete the registration of students with high efficiency. Therefore, the study of existing technologies such as Bluetooth [4-8], QR code (by utilizing mobile phones), RFID, IMEI, fingerprint, hand geometry, and the iris is needed to discover suitable ways to implement the proposed system. Indeed, different factors for measuring the efficiency of proposed system needs to be taken in considerations such as cost, time taking per student, performance, acceptance, usability, and the possibility of adopting and implementing the environment of the university. Using Cloud Computing will

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raise some problems and limitations because the applications that use cloud need a constant Internet connection with high speed [9,10]. Also, this research will include three types of identification technologies, which are Bluetooth, near field communication (NFC), and Radio frequency identification (RFID) [11].

The work aims to propose Mobile Cloud Computing model as a solution for students' attendance. Also, it will build and design a desktop and cross-platform mobile application to control the attendance as depicted in Figure 1.

TABLE 1: BLUETOOTH TRANSMITTER POWER CLASSES

Power Class	Maximum Output Power	Operating Range
Class 1	100 mW (20 dBm)	100 meters
Class 2	2.5 mW (4 dBm)	10 meters
Class 3	1 mW (0 dBm)	1 meter

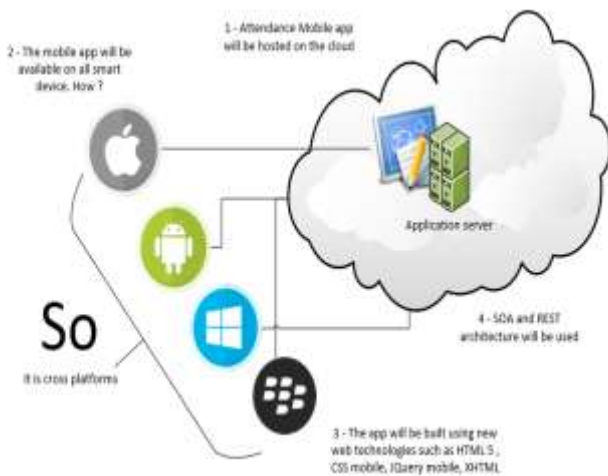


Fig. 1. Overview design of students' attendance management

II. BLUETOOTH TECHNOLOGY RANGES

Bluetooth technology range is application specific. The Fundamental Specification mandates that one meter is the minimum range of Bluetooth. According to the official website of Bluetooth organization, there is no limit for the range of Bluetooth, the manufacturers they can provide the range needed which support their use cases for different solutions. However, the range of Bluetooth technology depends on the power class, which is used in the implementation. There are three core radios classes of Bluetooth technology as shown in Table 1. Class one radios can be found in industrial use cases, which has a maximum range up to 100 meters. Class two radios mostly found in mobile devices, which has a range of 10 meters. Moreover, the range of Class 3 is one meter. Bluetooth core power class one could be used to cover classroom with dimension 200M*200M, because as we know the range of class 1 is 100 meters, so by putting Bluetooth transmitter device with Omni-directional antenna in the middle of the classroom as

shown in the Figure 2, we can get double range, which is 200m.

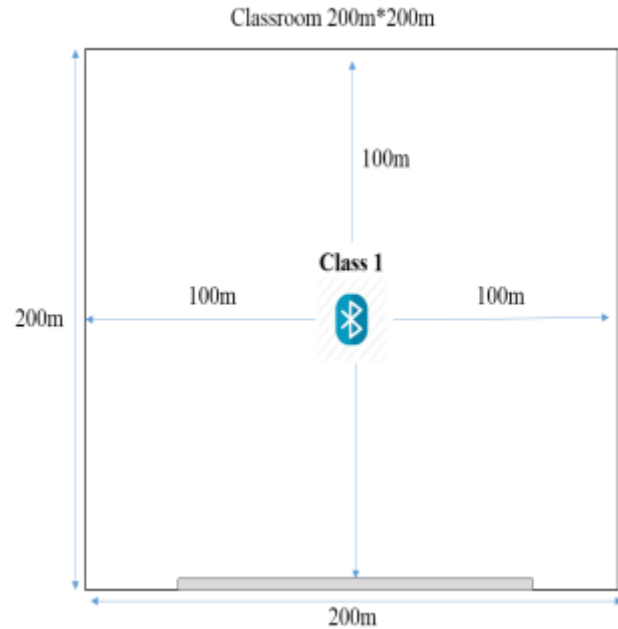


Fig. 2. General overview of the MCC model

III. NFC STANDARDS AND COMPATIBILITY

NFC is a short-range contactless wireless communication technology. It provides a safe and straightforward way for electronic devices to start communication between each other. It based of RFID. Users who have NFC-enabled devices such as Smartphone or tablet they can get in an easy way to link their devices to other NFC-enabled elements to start the communication. The communication between NFC-enabled devices is within few centimeters as it a short-range wireless technology. The advantage of short transmission range is that it prevents eavesdropping on NFC-enabled transactions. NFC has sets of specifications like:

- Operates within available and unlicensed radio frequency ISM band of 13.56 MHz. The bandwidth of NFC is almost 2 MHz.
- Working distance up to 20 cm with standard antennas.
- Supported data rates 106, 212, or 424 kbit/s.
- NFC has two modes: Passive Communication Mode and Active Communication Mode.

There are two coding to transfer data, modified Miller coding, and Manchester coding. NFC-enabled Devices have the ability to transmit and receive data at the same time.

NFC is an open platform, developed by Sony and Philips. NFC which described by NFCIP-1 is standardized in ISO 18092, ETSI TS 102 190 as well as in ECMA 340. Using standard to specify capabilities like encoding schemes, the architecture of frame, modulation, transport protocol, and data transfer speeds. In addition, the standardized described the two modes of NFC which are passive and active modes, as well as specify the conditions needed to avoid collisions while initialization. However, NFC device do not use NFCIP-1 only, but there is NFCIP-2 which is standardized in ISO 18092, ETSI TS 102 190 as well as in ECMA 340. There are three modes that could be selecting. NFCIP-2 allows selecting of one of these three modes:

- NFC data transfer (NFCIP-1),
- proximity coupling device (PCD), defined in ISO 14443, and
- Vicinity coupling device (VCD), defined in ISO 15693.

IV. LITERATURE REVIEW

Marcos et.al. [12], developed an attendance control system, as a solution for student's attendance using NFC technology. The students used their mobile devices, enabled with NFC. Students, who have mobile devices without NFC technology, have been asked to use NFC tag which. Also, they developed mobile application using jQuery Mobile [13], the mobile app provided information about the subjects, the student has enrolled-in, and calendar with indication of classes missed or attended. Patel, et. al. [14] proposed an architecture for attendance system using RFID technology. Their proposed architecture consists of RFID tags, RFID reader, database server, application server, and middleware. During class time, RFID reader scans students' tags and then sends the collected information to middleware layer to perform some filtering. In the application server layer, there is software receives row data and then query the database to search for student ID and mark him/her as a present. The Proposed architecture automated the attendance process with using of less costing materials.

Zhao and Gao suggested and implemented dynamic attendance system [15]. The system consists of four main parts include RFID tags, RFID readers, transmission network, and server. The tags can transmit signals to be detected by the RFID reader. The user is responsible for reading the information of the electronic tags. The transmission of data is conducted through the transmission network. Whereas the server is responsible for processing the data as well as updating the database after the attendance is over. To record the attendance in a classroom, the server will invoke the RFID reader. This will be sent through the transmission network. Then the RFID reader read the students' tags in a classroom. Then collected data of students will be sent back to the server, and finally, the server will query the database to store the data to identify who attend the class. The proposed system by Zhao and Gao had weaknesses such as inaccuracy of the RFID reader while reading students' tags of adjacent classrooms. To come over this problem, they proposed the date comparison algorithm, to eliminate the interference of other RFID tags of the adjacent classroom. Ivanilson et. al., introduced an automatic attendance register system for the Cape Peninsula University of Technology. They concluded that the proposed Academic attendance register system would help lecturers to keep track of students, measure their attention, and determine their performance. However, due to inefficient and inconsistent of the manual attendance system in the Cape Peninsula University of Technology, they studied set of possible technologies as a solution to gather, store, process, and validate student attendance. They evaluated the best solution which can be suitable for the environment of the University. They suggested a set of technologies including Bluetooth, QR code, and RFID. Bluetooth is a wireless technology which used a radio link 2.4-GHz. Shoewu et. al., proposed an attendance system through using fingerprint; as a solution for student identification in the classroom. However, their proposed solution for attendance system using biometrics improved the performance over the manual method. It takes 3.79 seconds for

80 candidates while the manual attendance takes 19.83 seconds, so the success rate for the system was 94%. However, in the enrollment stage, information about student name, gender, ID, and the fingerprint are stored in the database. The fingerprint is captured using fingerprint device. Lecturers can generate a report for each student that shows the percentage of student attendance. The proposed Software Architecture consists of database and application program. The type of database is Microsoft SQL Server database. It was used to store student's attendance records. The application program developed by C# programming Language using visual studio, to provide the end user interface for Attendance Management System [16]. Nawax, and Pervaiz [17], they proposed automatic attendance system, by using a fingerprint to obtain student's attendance. They decided to use fingerprint in their proposed attendance system because of the simplicity and accuracy provided by fingerprint and it widely used for identification. Regardless of simplicity and accuracy, there are two main critical factors which make it as one of the best solutions; persistence (the features do not change) and individuality (the fingerprint for each one is unique) [18,19]. The fingerprint is one of the most mature biometric technologies. The components of proposed system consist of students, fingerprint device, LCD screen, and database.

V. PROPOSED SOLUTION

The proposed solution for registering the student's attendance consists of three primary levels. These levels are including the following:

- Private Cloud and user level: It has the education institution servers, computers, hardware, and user's devices (smartphones, tablets, PCs).
- Communication and network level: This level contains all network equipment such as switches, routers, and cables. It allows the users connect to the public cloud and request the information, which is stored in the cloud using their Smartphone or tablets from anywhere.
- Public Clouds has the Information management, data mining and analysis level: public clouds, information management and analysis clouds. The information of students, lecturers, courses, and classes will be stored and processed in this level.

Figure 3 illustrates these three levels Private Cloud and user level, Communication and network level, and Public Clouds, Information management and data analysis level of proposed solution. Proposed solution consists of two parts: the first part is students' attendance registering system, and the second part is students' attendance management system as mobile application. The first part of proposed solution is windows form application that is written using C# language of .Net framework. This application is need to be installed on all classroom's PC which is a built-in Bluetooth device. The application will utilize the built-in Bluetooth device in the PC to discover students' devices, if they use smartphone such as iPhone, Galaxy, HTC, or Nokia. Or even a tablet. The student's devices should have Bluetooth put it in enable mode. However, this application will search and detect the students' devices MAC address and store them in a cloud database corresponding to student identification number. In the lecture session, the application will detect all MAC addresses and store them in the

array to match up with Student's list, and register them as attending. The traditional method is to register the MAC address for each student one by one in the students' information database. This procedure will consume the time and will need more effort. The advanced method is to tell all students in the classroom at the first class session changing their device Bluetooth name to be their Student ID. The application will start to discover and search students' Bluetooth Address plus Bluetooth name, then will run a query to update student information record to set the MAC address for each student. The proposed attendance registration system consists of four main components. These components are PC with the built-in Bluetooth device, Desktop application. Figure 4 shows these four main components.

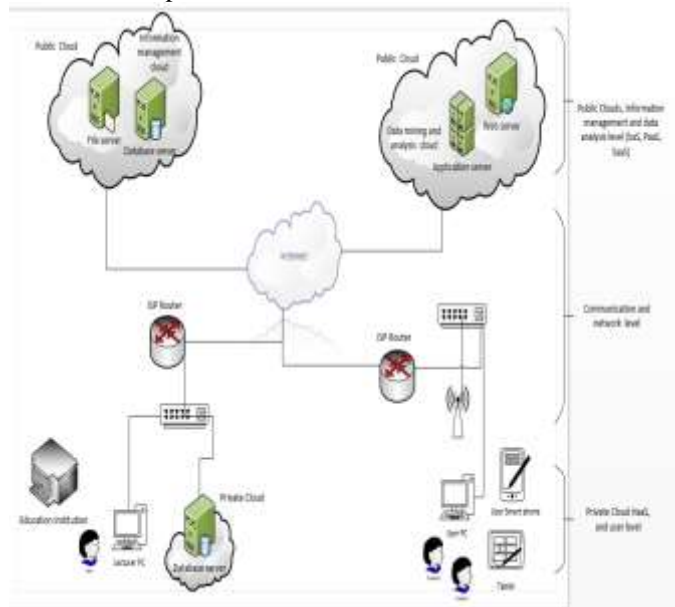


Fig. 3. Mobile Apps framework design

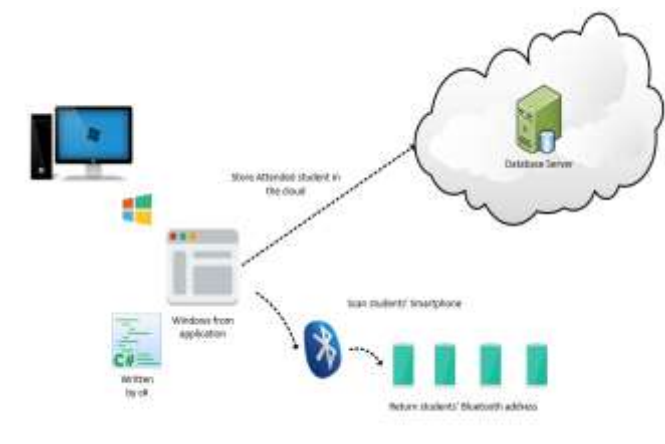


Fig. 4. Students' attendance registering system

A suitable architecture must be implemented to make the desktop application used internal network structure and communicated with external worlds such as public cloud IaaS and PaaS. Today's set of architectures can be used to communicate with remote servers. This includes the Service-oriented architecture technologies such as SOAP or REST, or use the traditional Client-server architecture. The SOAP or

REST will let you decouple the functionality from the presentation of the application. SOAP and REST are used for creating an API, which will be used and utilized by other programmers as a web service. However, in the proposed system used client-server architecture, that is because it gives us the ability to use database server remotely without any constraints. Figure 5 represents database tables of the proposed system. This scheme represents a full academic system; we will focus on students' attendance as a prototype of the academic system.

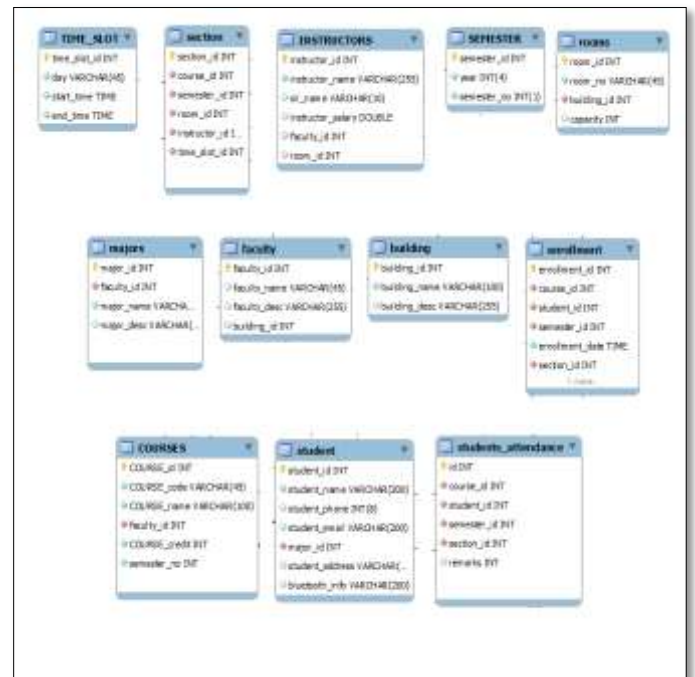


Fig. 5. database & tables of proposed system

VI. ATTENDANCE REGISTRATION FORM

Attendance registration form is the backbone of the proposed system; it has mostly critical functionalities. This section will present an overview of the parts of attendance registration form. The current date, semester code, and lecturer name will appear. The primary information of the sections for a lecturer such as the courses list, time, location of the classroom and some students. When the lecturer chooses the course name, the start time, the classroom number, and the number of students registered in the section will be filled automatically based on a date of lecture. Apparently, this form displays the Students' absence details in a Grid View. Figure 6 shows the wireframe of Attendance registration form. Each Bluetooth-enabled device must contain MAC address; this address is unique for each device, which means that it cannot be repeated. In The proposed solution we used this MAC address for identifying the students, so the scan button will detect the students' devices and locking for the MAC address, which will represent the Student's phone.

Figure 7. At the beginning of the semester, the lecturer should tell students to change their Bluetooth's name to be their Student ID. Then the lecturer will have to request the system to start discovering Students' Bluetooth MAC address as well as Bluetooth's name; this information will be stored in a 2-

dimntion array. When this process ends, the connection to cloud database will be opened.

Student ID	Student Name	Time	Attend	Excuse	Rate
131377	Majed Omar	08:00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	50%
131387	Issa mohammed	08:00	<input type="checkbox"/>	<input checked="" type="checkbox"/>	10%
131367	mohammed salah	08:00	<input type="checkbox"/>	<input type="checkbox"/>	0%

Fig. 6. The main from of Attendance registration

After that, the system will loop on the 2-dimntion array, in each iteration a query will be made to the database to update student's record to set the MAC address for that student. After detecting students who are in the classroom, we have to store absence student in the cloud database. Until this stage, we already have the MAC address of students who are in the classroom. To register the attendance, we check, at first, if the attendance of this section is taken or not then, compare the array of students who are registered in the section with the array of discovered devices after filtering and removing students who do not belong to the classroom. By looping through the array of discovered devices, at each iteration, we check if the element is in the array of students who are in the classroom. If the item is not stored in the student array, that means that the system does not detect student's device. Then, a connection to cloud database will be established to query the database to mark this student absent. Simultaneously, the system will check the absence percentage for this student. If the percentage is greater than 10%, the system will send SMS to the student as a warning message. However, at the end of this process, all absent students will be stored in the database. Figure 8 illustrate the process of Register students' attendance.

VII. ATTENDANCE MANAGEMENT MOBILE APP

A prototype for managing and control the registration of student attendance is developed using Phone Gap and jQuery mobile framework. There are two parts of the app, front-end, and back-end as well as it uses MVC development pattern. The front-end is the view where the user can interact with the components. It was designed and developed using HTML 5, JavaScript, CSS, and J-query. The back-end is the controller, which is programed using PHP language. Usually, the request is passed from jQuery to query the database, and it represents the model. However, jQuery Mobile allows simplifying and improving the development of mobile web applications by integrating HTML5, CSS3, jQuery and jQuery UI. However, the mobile app will be hosted in the cloud as SaaS. To make this app

available for students, another mobile app using PhoneGap is created. This mobile app will redirect the user to students' attendance management web based on the app. The PhoneGap allows us to compile the app to any OS platform, so we compile the app then it will be ready to be installed on any smartphone.

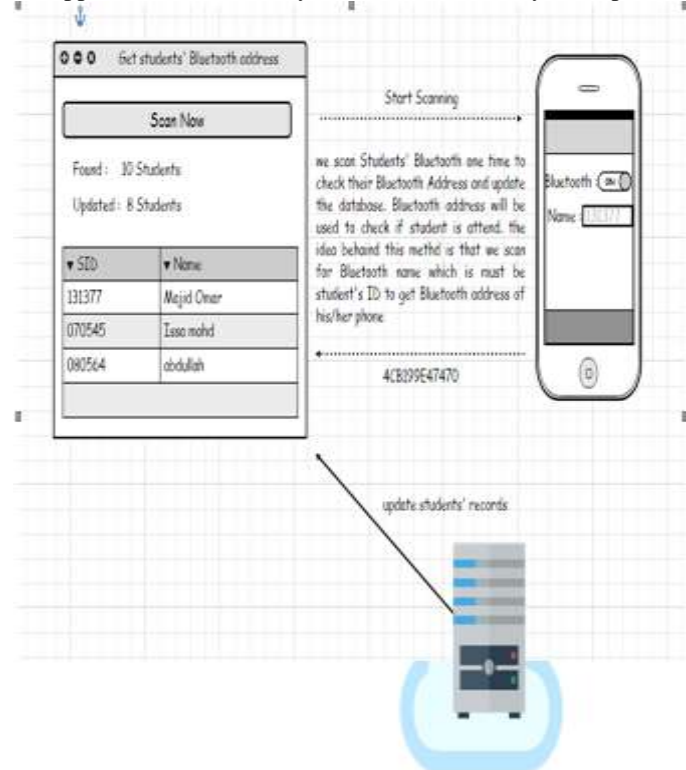


Fig. 7. lookup Students' Bluetooth MAC address

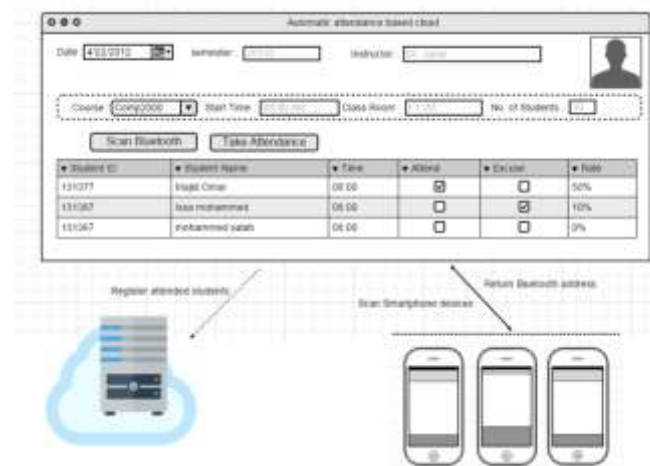


Fig. 8. register student's attendance

However, the mobile app was designed for one purpose; the purpose is to allow students to check their attendance details, such as the number of missed classes, and the percentage of absence. The app is simple; it has login view where the student can log in, by entering his/her student ID and password, sign up, the student can get his/her password, for the first time student must sign up, to be able to access. The app also has the main view where the list of courses displays, and view to show

the absence details for each course. The Figure 9 shows and summarize students' attendance management mobile app.

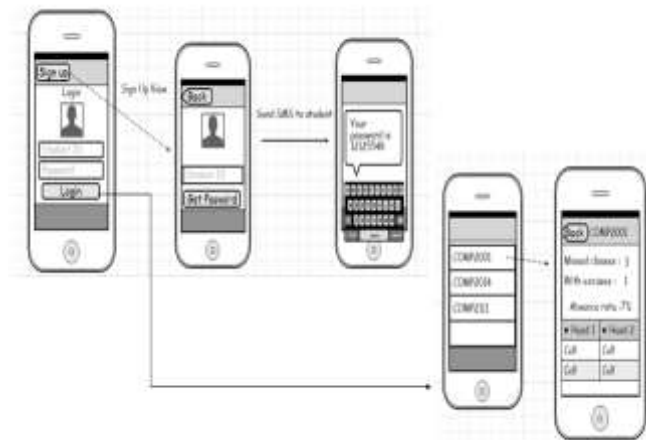


Fig. 9. views of students' attendance management app

In addition, Figure 10 depicts the Screens of attendance management app



Fig10. Screens of attendance management app

VIII. CONCLUSION AND FUTURE WORK

Automate the process of registering students' attendance using Bluetooth technology help to reduce the falsification of attendance, which make students attending classes regularly. However, the benefits of using cloud computing and mobile technology in education institution that because it cost less than a traditional data center [20]. Registration of student attendance is not easy, especially if the classroom has a big number of students. This process consumes the time and effort of the

lecturer to complete the attendance record and then insert into the official attendance record. In many cases, the recording of attendance is inaccurate because it relies on manual monitoring and manual recording, thus eliminating the benefit of this process.

Therefore, the proposed system helps to complete the process of recording students' attendance through the use of automated methods based on the recognition of the address of phone devices to students through Bluetooth technology. And then register addresses with a database in a cloud site to provide flexibility and speed to update and access data. Also, a smartphone application was designed and implemented to enable students to follow up and learn about the attendance of their courses, to know the percentage of students enrolled in the course and any guidance messages from the lecturer to the student. The proposed program has helped reduce attendance errors and reduced the time and effort required to complete the attendance registration process. Moreover, using the Bluetooth address for the student attendance registration based on the cloud will be costless, that is because all students have their smartphones with built-in Bluetooth. It also relied on smartphone applications for speed, data access, and first-rate absences.

Relying on the Bluetooth address technology in recording the student's address in which some disadvantages such as the limited range of Bluetooth and any student can register attendance from outside the boundaries of the lecture hall if the student within the scope of broadcasting Bluetooth. A student can also use his friends' phones to record MAC address and then registered as attending. Therefore, it is proposed to add a counter to using the Arduino Uno board and built counter sensor after connect photoresistor and resistor to the board as shown in Figure 11. Another solution is to apply the techniques of analyzing and identifying the student image by installing a camera at the entrances to the halls [21-28], and then analyzing the entry card information for each student using natural language processing [29-38].

The future directions of this work is to design and implement other authentication methods, so that ensure each student has a unique address.

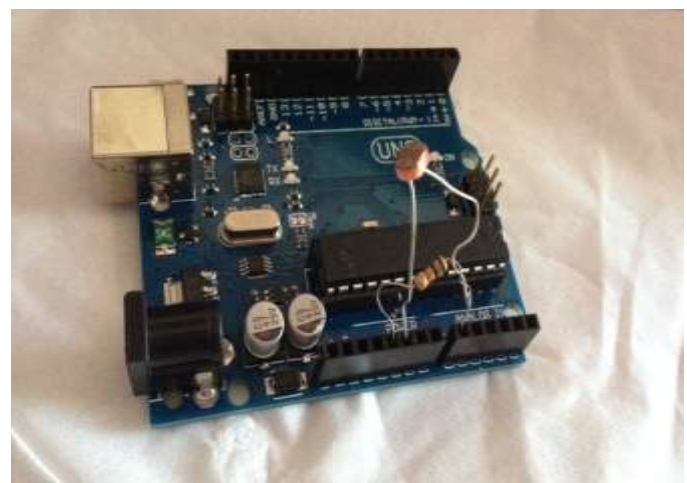


Fig11. studentcounter sensor based photoresistor and resistor 10k ohm.

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